A Standard Bank-Fund Projection Framework with CGE Features

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Abstract

We present a SAM-methodology for integrating simple macroeconomic and CGE models, which is applied to integrate standard versions of the merged and static CGE model frameworks. The integrated model accounts for relative prices and income distribution. A set of integrated model projections is compared with a set of merged model projections. While relative price changes generally benefit poor rural households, in particular, the accompanying capital deepening of the economy benefits urban households in relative terms. The integrated model projections imply that the previous set of merged model projections overlook an undesirable - but likely - distributional impact.

1. Introduction

During the past four decades, two widely used frameworks for macroeconomic analysis in developing countries have been the financial programming (FP) and the revised minimum standard model (RMSM), associated with respectively the International Monetary Fund (IMF) and the World Bank (WB) (Agénor and Montiel, 1996). Khan, Montiel, and Haque (1990) merged these two approaches in their theoretical model designed to analyse growth-oriented adjustment issues. However, the merged model leaves much to be desired. Bringing the FP and RMSM modelling approaches together entails the explicit inclusion of price indices for domestic and traded goods, but trajectories for the price indices are exogenously specified. There are no explicit links among projected economic growth, factor supplies and total factor productivity (TFP), and no attempt is made to relate behavioural relationships or exogenously specified outcomes to decisions made by optimising agents. Finally, distributional issues cannot be addressed. In contrast, these issues are central in the context of computable general equilibrium (CGE) models.

We propose to address the shortcomings of the merged model by integrating the CGE methodology with the Bank and Fund approaches. The point of departure is the simple operational version of the Bank-Fund framework outlined by Brixen and Tarp (1996). The national accounting identities of this model are set out in a social accounting matrix (SAM), and it is shown that there is a direct link between the SAMs covering (i) the real sector in the application of the merged model to Mozambique in Jensen and Tarp (2000), and (ii) the static CGE model developed for Mozambique by Arndt, Jensen and Tarp (2000b). In this way we establish a combined SAM framework that forms the basis for an integrated dynamic CGE model with a financial sector. This model incorporates macroeconomic features of the kind captured by the merged model, and addresses the shortcomings of the merged model.

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The workings of the above model are illustrated through an application using Mozambican data. The calibration of model parameters is based on 1995 SAM-data from Arndt, Cruz, Jensen, Robinson, and Tarp (1998) and more recent national accounts. It emerges that relative prices and developments in the factor markets, which are not captured by the merged model, are important. Compared to simple Bank-Fund merged modelling, the explicit inclusion of CGE features in the integrated model therefore allows the analyst to focus more sharply on the preconditions regarding factor supplies and productivity underlying assumed growth paths. The impact on the distribution of income can also be derived. Increased detail comes at the expense of harder data requirements. However, the growing availability of SAMs for a wide range of developing countries shows that such data requirements can in many cases be fulfilled in practice without major difficulty. Implementation of the model suggested in this paper is therefore not only desirable but also a feasible operational proposal for how to move beyond the simple Bank-Fund framework.

Following this introduction, the merged and CGE model approaches are discussed in Section 2. We also present the combined framework of real and financial SAMs for these two models. They are used in Section 3 to formulate the integrated dynamic financial CGE model. Section 4 identifies the data necessary to calibrate the parameters of the integrated model. Since the real SAM is not fully up-to-date for making future projections, the calibration of model parameters relies on an updating procedure which allows the model to target key macroeconomic aggregates, while preserving important sectoral characteristics embodied in the 1995 real SAM. In Section 5 we present our 1998-2002 economic projections for Mozambique, and conclusions are drawn up in Section 6.

2. A comprehensive SAM framework

The structure of the static Mozambican CGE model formulated by Arndt, Jensen and Tarp (2000b) is based on an accounting framework which can be summarized by the macroeconomic SAM in Table 1. This SAM has some dimensions which are particularly useful in relation to data handling for CGE models. The distinction between activities and commodities in the market for goods and services allows us to (i) keep the production and retail levels in the marketing chain separate, and (ii) retain information on the specific structure of the use matrix of intermediate inputs and the make matrix of marketed domestic production.

The distinction between activities and commodities is also suggestive for other reasons. First, it allows us to keep separate accounts for domestic sectoral production including production specific taxes, and overall sectoral supplies including other indirect taxes at the retail level. Second, it makes it possible to retain sector-specific information on the costs associated with marketing of goods in a way which makes it clear that the costs constitute a wedge between producer and consumer prices. Third, it is a convenient way to keep account separately of sectoral imports and the sectoral use of intermediate inputs. Imports are included among the supply of goods in the commodity account columns, while production activities demand intermediate inputs from the commodity account rows.

[TABLE 1 ABOUT HERE]

Detailed accounts for the income flow from production factors to enterprises and households is another dimension of the data handling SAM framework which is especially useful for the CGE model. The standard CGE model is based on a set of production functions which functionally relates sectoral production to sectoral inputs of production factors. Several factors of production are typically included since factor intensities differ between production sectors. A

standard CGE model also embodies optimising agents who make sectoral production decisions based on sectoral profit opportunities, and the model explicitly accounts for sectoral (re-) allocation of production factors. Due to the sectoral differences in factor intensities, relative factor prices change with sectoral production opportunities. Changing relative factor prices are important to capture. They imply changes in the factorial distribution of income. Moreover, households differ in their relative supplies of factors, so changes in relative factor prices affect the distribution of household income. Finally, expenditure patterns also differ between households, so careful modelling of the income flow from production activities to households is important. Overall, separate factor, enterprise and household accounts are important in the CGE model framework. They form the basis for modelling the household income flow.

While the distinction between activities and commodities in the goods market and detailed information on the household income flow are useful for the CGE modelling approach, these features are not so important in standard macroeconomic models. Typically, they do not rely on the sectoral detail available in the use and make matrices of the SAM framework.[2] Moreover, attention is generally not paid to differential treatment of taxes, and marketing margins and home consumption of own production is not accounted for. There is therefore no need to maintain a distinction between activities and commodities in the SAM framework for the ordinary macroeconomic model. Furthermore, the lack of sectoral detail implies that detailed information on income flows is not necessary either. Macroeconomic models typically operate with aggregate income numbers, where value added at market prices is distributed directly among aggregate private and government sectors. There is no need for separate factor, enterprise and household accounts in the SAM framework for a typical macro-model, which cannot be used for distributional analyses.

The above mentioned distinguishing features of the typical macroeconomic model are also characteristic of the merged model. This model incorporates very little sectoral detail. In particular the merged model relies on an aggregate resource balance, so this model operates with only one goods account. This shows that the activity and commodity accounts from the CGE model framework correspond to a single aggregate goods account in the merged model framework. In addition, the merged model distributes exogenously imposed income directly to the government and an aggregate private sector. The factor, enterprise, and household accounts from the CGE model framework correspond to one single private sector account in the merged model framework. Apart from these aggregate accounts, the dimensions of the merged model framework presented in Table 2 corresponds closely to the dimensions of the CGE model framework in Table 1. In sum, the real side of the merged model framework corresponds to the CGE model framework, where the activities and commodities accounts have been aggregated into one goods account, while the factor, enterprise and household accounts have been aggregated into one private sector account.

[TABLE 2 ABOUT HERE]

In order to arrive at a complete SAM framework for the merged model, the real side SAM in Table 2 has to be supplemented with a financial side SAM. The financial sector of the merged model can be categorised into five accounts, namely (i) Domestic Capital Market, (ii) Foreign Capital Market, (iii) Private Investment, (iv) Government Investment, and (v) Savings-Investment Balance. The financial side SAM of the merged model is summarised in terms of these

[2] The merged model does include some sectoral detail in relation to the specification of sectoral growth paths for real GDP and exports. However, such information does not rely on the distinction between activities and commodities accounts in the SAM framework.

accounts in Table 3. While the Savings-Investment Balance actually derives from the combined Private and Government Investment accounts from the real side SAM in Table 2, the remaining four accounts are necessary to ensure consistency between savings, investment and financial flows.

The Private and Government Investment accounts ensure that sectoral imbalances between savings and investment are financed by borrowing in the foreign capital market or the domestic money market. In addition, the Domestic Money Market and Foreign Capital Market accounts ensure that private and government borrowing from domestic and foreign sources are consistent with changes in the money stock and the balance of payments.[3] All domestic financial liabilities are therefore included into the broad money stock concept which forms part of the model. The Domestic Capital Market account in Table 3 indicates how this concept of broad money relates to the expansion of domestic credit and foreign exchange reserves.

[TABLE 3 ABOUT HERE]

The above discussion shows how the Mozambican static CGE and the merged models are related. The SAM for the CGE model can be reduced so it corresponds to the real side of the merged model, and a simple SAM can be established for the financial side of the merged model. In sum, the combined SAM framework consisting of the real side SAM in Table 1 and the financial side SAM in Table 3, makes up a comprehensive set of SAMs for the two models.

3. The integrated model

In order to see more specifically how the comprehensive SAM accounting framework can be used to integrate the two models, it is useful to summarize the underlying relationships between variables in the models. The accounting identities underlying the relationships among variables in the merged model are presented in Tables 4 and 5. The savings-investment balance in the financial SAM can be derived from the private and government investment accounts in the real SAM. The real and financial side frameworks are therefore related through the definitional relationship between the two investment accounts on the real side and the savings-investment balance on the financial side.[4]

The real side variable relationships indicate that the difference between private income and expenditures is made up of net private savings (SP) and foreign interest payments (INFP). Foreign interest payments subtract from gross savings to arrive at the net savings which enter the financial side variable relationships. The same logic applies to the government investment account. Foreign interest payments do not explicitly enter the savings-investment balance in the financial sector of the merged model. In an accounting sense they net out in the aggregation of the private and government investment accounts. Nevertheless, the foreign interest payments are included implicitly, since foreign interest payments reduce the size of the net savings variables.

The definitional relationship between increasing broad money (MD) and increasing domestic credit (DCP and DCG) and foreign exchange reserves follows from the domestic money market account. Since broad money is an asset of the private sector only, the model assigns all seigniorage to the government sector. Intersectoral interest payments between the private and

[3] The framework does not include any domestic capital market for longer term domestic borrowing. This simplification is based on the observation that the Mozambican capital market is very thin.

[4] There are also feedback effects from the financial side onto the real side in the merged model. Increased foreign borrowing on the financial side leads to increased interest payments which lower savings on the real side. However, all interest payments are accounted for in the investment accounts as well.

government sectors in relation to domestic credit taking are not included in the model. The allocation of credit is not an issue at the current level of aggregation in the merged model.[5] This is so since the government has privatised all commercial banking activities, and since government domestic credit taking is low.

The sources of broad money expansion also include the accumulation of foreign exchange reserves. The domestic currency value of reserves can change either from the building-up of foreign currency reserves (R) or from changes in the exchange rate (E). In the merged model, the revaluation of foreign exchange reserves are assumed to fall into the hands of the private sector. A depreciating exchange rate generates private income from this source. Together with private and government foreign borrowing (NFDP and NFDG), the revaluation of foreign exchange reserves help to finance the deficit on the balance of payments.

[TABLES 4 AND 5 ABOUT HERE]

The real side variable relationships in the merged model mirror the variable relationships in the static CGE model presented in Table 6. The SAM accounting framework for the CGE model encompasses the real side framework of the merged model. Since some of the accounts in the merged model map into multiple accounts in the CGE model, problems might arise in relating the financial sector of the merged model to the real sector in the CGE model. However, this does not represent a problem with the current models. The investment accounts in the merged model framework in Table 4 and in the CGE model framework in Table 6 are almost similar in dimensions. The aggregation into one private sector account implies that enterprise and household savings (ENTSAV and HHSAV) are aggregated into gross savings in the merged model. This implies that an equation has to be added which defines private net savings as the difference between the sum of enterprise and household savings, and private interest payments.

Altogether, the two SAM frameworks in Tables 4 and 6 also show that simple relationships exist among the financial sector variables from the merged model and the real sector variables in the CGE model. First, enterprise and household savings in the CGE model add up to net private savings plus private net foreign interest payments in the merged model. Second, recurrent government savings (GRESAV) in the CGE model represent gross government savings, and add up to net government savings plus government net foreign interest payments in the merged model framework. Third, foreign aid inflows into the government budget (FAIDGIN) in the CGE model are net of foreign interest payments, so this flow amounts to the difference between net unrequited transfers to the government (NTRG) and government net interest payments in the merged model. Fourth, the foreign savings inflow into the private investment account (FSAV) in the CGE model is net of interest payments since it adds up to the difference between the current account deficit (-CURBAL) and private net foreign interest payments in the merged model. Fifth, the deficit on the government investment budget (-GINSAV) in the CGE model maps into the difference between the overall government borrowing requirement (BRG) and gross savings on the recurrent budget.

[TABLE 6 ABOUT HERE]

Four of the five relationships between variables in the investment accounts of the CGE model and the merged model outlined above are fundamental for the integration of the two

[5] Clearly, interest rates in both formal and informal markets are high and important for credit allocation between private sector agents in Mozambique. This issue disappears with an aggregate private sector.

models. However, there is no need to explicitly define the government borrowing requirement in the integrated model. It follows that it will not be necessary to include the fifth relationship identified above which defines a relationship between the deficit on the government investment budget and the overall government borrowing requirement. Nevertheless, there are two other relationships which need to be established between variables in the merged model and the CGE model, see Tables 4 and 6. Foreign aid inflows into the NGO budget (FAIDNGO) in the CGE model is equivalent to net transfers to NGOs (NTRNGO) in the merged model. Moreover, remittances (REMIT) in the CGE model is equivalent to net factor payments (NFP) in the merged model, since net transfers to privates (NTRP) are zero throughout the base years and the projection period. In sum, six relationships among variables in the CGE and merged model need to be established in order to integrate the financial sector from the merged model with the real sector from the CGE model.

Once these six relationships have been established, they are supplemented by four accounting identities. They ensure that the accounting identities included in the financial SAM framework in Table 5 are fulfilled. Accordingly, borrowing in the domestic money market and in the foreign capital market is consistent with the money stock and the balance of payments. Moreover, imbalances between savings and investment are financed both in the private and government sectors. The accounting identity defining the savings-investment balance in the merged model does not need to be included since it amounts to the sum of the private and government investment accounts in the CGE model.

In addition to the 10 consistency relationships already defined, the financial sector of the integrated model is characterised by five more relationships. Two of these relationships define private and government foreign interest payments from their net foreign debt in the previous period. Finally, three technical and behavioural relationships close the model. The first defines the government net foreign debt as a fixed share of export earnings. This is a technical relationship which allows the analyst to implement the assumed impact of the HIPC initiative in a simple way.[6] The second behavioural relationship defines the accumulation of foreign exchange reserves as a linear function of changes in import expenditures. This specification tracks government objectives regarding the level of foreign exchange reserves in a simple way.[7] The third behavioural relationship defines the demand for money from a simple quantity equation specification. Altogether, fifteen equations are needed in order to integrate the financial sector of the merged model with the CGE model.

Projections with the merged model are driven by exogenously specified growth paths for GDP and exports.[8] This is, however, not the case in the static CGE model where GDP growth is driven by the accumulation of factor supplies, while exports are determined by GDP growth and relative prices. To turn the static CGE model into a dynamic model it was necessary to specify updating formulas for the factor supplies which drive growth. Simple updating formulas with fixed growth rates were included for the updating of labour supplies. In contrast, the updating formula for the capital stock was related to total investment expenditures in the previous period. This

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[6] At the time of writing, the HIPC initiative was assumed to reduce the government net foreign debt to 200 percent of aggregate export earnings in mid-1999.

[7] The government objective is to maintain foreign exchange reserves at a level which can finance five months of additional imports.

[8] Note that the merged model has other dynamic elements, including the relationship between GDP and investment, as well as financial relationships defining foreign interest payments and the accumulation of domestic credit, foreign debt and foreign exchange reserves. The dynamic financial relationships are also included into the integrated model.

formulation implies that government and private investment are added to the capital stock (after depreciation) which is subsequently allocated among production activities. However, the formulation suffers from a units problem. The factor supplies are defined in terms of value added while investment is defined in terms of ordinary expenditures. In the current context this problem was solved by scaling down the investment aggregates before adding them to the capital stock.[9] The final step in the specification of the integrated model was to provide all variables in the CGE model with a time index.[10]

4. Data and calibration

The integrated model defined in the previous section was based on a comprehensive SAM accounting framework. The data needed for calibrating the integrated model can therefore be identified from this framework. However, a financial SAM with the dimensions given in Table 4 will not provide enough information for model calibration. No information is e.g. available on the levels of financial aggregates. This is important since foreign interest payments depend on the foreign debt in the previous period. In addition, the level of government domestic credit typically acts as a key target variable when Bank-Fund models are used to make projections. In order to capture all variables of the model, base year data were therefore organised inside a spreadsheet.

The real sector of the integrated model resembles the original static Mozambican model in most respects. The 1995 real sector SAM which formed the basis for the static CGE model can also be used as a basis for the integrated model in combination with a financial sector data set.[11] It was decided that the forecast horizon for the projections should cover 1998-2002, since reliable national accounts and financial sector data were available up until 1997. However, the real sector of the integrated model requires detailed sectoral information which is only available from the 1995 SAM. It was therefore decided to calibrate the integrated model to a complete 1995 data set, consisting of the 1995 real sector SAM and a consistent set of financial sector data. Subsequently, the model was run forward to capture key national accounts and financial sector aggregates in the following years without changing structural details such as the input-output table.

The real SAM data set for 1995 was developed with the specific purpose of establishing a comprehensive data base with a detailed picture of the agricultural sector. The data set includes 40 production activities, among which 12 primary agricultural sectors and two agricultural processing sectors. Furthermore, the SAM includes 40 retail commodities, which map almost one-to-one to the production activities, three factors of production, including agricultural and non-agricultural labour and capital, and two urban and rural households.[12] Such a detailed description of production activities and retail commodities is not required for current purposes. The 1995 SAM data set was aggregated into four production activities including agriculture, industry,

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[9] The scaling factor is equal to the returns to capital. In the current Mozambican context, returns to capital are assumed to be 20 percent. This is close to the estimate provided by Arndt, Robinson and Tarp (2000).

[10] The full set of integrated model equations are available in Jensen (1999).

[11] The data underlying the specification of the static CGE model stem from a recently developed SAM for 1995 (Arndt, Cruz, Jensen, Robinson and Tarp, 1998). A thorough description of the features inherent in the SAM can be found in Arndt, Jensen and Tarp (2000a).

[12] Land is not included among the production factors, because of data availability. However, it is also clear that land in Mozambique is abundant in most instances. It follows that returns to land are likely to be small and without significance for modelling purposes.

services and marketing services, and three retail commodities including agriculture, industry and services. The disaggregation of factor and household accounts was left unchanged, in order to retain the important factorial income distribution.

The running-forward of the model means that the value of many parameters changes between 1995 and 1997. Nevertheless, there is a set of key parameters which does not change as part of the targeting exercise. One group defines technologies used in production activities from sectoral use of intermediate inputs and factorial distribution of sectoral value added in the 1995 SAM.[13] The SAM data set implies that production sectors differ significantly in their relative use of intermediate inputs and primary factors. At one extreme, agricultural production which is dominated by small-scale peasant farmers stands out as an extremely labour-intensive sector which uses little intermediate inputs. At the other extreme, marketing service production is very capital-intensive with a reasonably high input cost share of total production value. While the industry and service sectors require more or less equal amounts of primary factor inputs, they are both characterised by high intermediate input cost shares exceeding 50 percent of production values. Indirect tax rates, i.e. production subsidy rates, are also kept constant during the running-forward of the model. They are, however, virtually non-existent and are therefore not important for model behaviour.

Another set of parameters which does not change during the running-forward of the model, is the factorial income distribution. This implies that the distribution of factor income among households differ significantly from factor to factor. The majority of value added by agricultural labour flows towards rural households, mainly small-scale peasant farmers. Nevertheless, urban households also use some human labour resources for agricultural production. Non-agricultural labour is employed in sectors which are more naturally situated near urban areas. However, since most Mozambicans live in rural areas, urban households receive only slightly more than half of value added by non-agricultural labour. Capital possession in Mozambique is mainly a characteristic of urban households. In spite of the fact that the rural population represents more than 80 percent of the total population, urban households receive the vast majority of value added by capital.

The second step in the "calibration" of the dynamic CGE model is to run the model forward to replicate the 1996-97 base year data. The updating of the base year data is important since significant changes have occurred during 1995-97, especially in relation to the import side, but also the domestic propensity to save and inflows of foreign capital have changed strongly. The targeting exercise will not allow for the complete replication of all nominal and real values. The running-forward of the model allows for the replication of all nominal values in the merged model projections, as well as real values of GDP and trade aggregates, and foreign currency values of capital inflows. Real consumption and investment aggregates are, however, not targeted. While NGO and government consumption overshoots by around 6 percent in 1997, the other major aggregates remain within 2 percent of actual national account numbers. The targeting exercise relies mainly on data available from the data set underlying the merged model projections in Jensen and Tarp (2000).[14] However, sectoral aggregates are also targeted where additional national accounts data are available. This is important for the tracking of sectoral trade aggregates and marketing service sector GDP.

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[13] The only parts of the production technologies which are allowed to change as part of the targeting exercise, is the productivity parameters.

[14] It is noted that the 1995 base year data set used for the merged model projections in Jensen and Tarp (2000) also resembles the currently used 1995 base year data set. While financial sector data were exactly the same, the real sector SAM data were aggregated appropriately for the merged model projections.

The targeting of nominal and real aggregates over the base year period 1996-97 implies that certain parameters must be allowed to change. The parameters of the model can be divided into those which have been previously estimated, and those which are calibrated on the basis of data and estimated parameters.[15] The estimated parameters include trade elasticities and minimum consumption levels. While trade elasticities remain fixed during the targeting exercise, the running forward of the integrated model implies that updating of the LES parameters is important. Accordingly, the estimated minimum consumption level shares were applied to the 1996 household consumption patterns to update minimum consumption levels and marginal consumption shares. The 1996 minimum consumption levels were subsequently imposed on 1997.[16]

The point of departure is to target real GDP for each of the four production activities. Allowing the productivity parameters of the production functions to vary implies that productivity in agriculture, industry and ordinary services have increased by between 6-14 percent annually during 1995-97. In contrast, productivity in the marketing service sector seems to have decreased strongly by an average 10 percent per year.

Trade aggregates, i.e. exports and imports, are also targeted for each of the three retail sectors. While the share parameters of the CET transformation functions change only slightly, the share parameters of the CES substitution functions decline more strongly reflecting that significant import substitution has occurred during the recovery years 1995-97. Targeting of real trade aggregates has implications for the treatment of net capital inflows from the rest of the world. While remittances by workers as well as foreign aid inflows into the government and NGO accounts are targeted, foreign savings inflows are left to clear the external account. Since implicit world market prices for imports and exports as well as the exchange rate are also tracked, all flows in the external account are targeted, including foreign savings inflows.

Turning to nominal variables, the targeting of nominal sectoral GDP requires two steps. First, total nominal GDP is targeted by varying the velocity of money circulation. Second, sectoral nominal GDP for agriculture and industry are targeted by varying sectoral marketing margin rates. Together, this implies that nominal GDP for the aggregate service sector is tracked as well. Since there are three different types of marketing margin rates associated with each sector, restrictions need to be imposed on the variation of the margin rates. It was decided that margin rates should vary proportionately sector-wise while the flat structure of import margin rates should remain constant.[17] While margin rates decline strongly for industry sector goods, the improvements are more moderate for agriculture. While the ratio between marketing costs and production value for domestically marketed agricultural products remain around 50 percent, the marketing cost ratio falls below 20 percent for industry sector goods.

Government savings are targeted implicitly through the targeting of government revenues and expenditures. In order to target government taxes, it was necessary to allow some tax rates to vary. Since changing indirect tax rates have implications for the GDP calculations, it was decided to limit attention to the factor, enterprise and household income tax rates. Due to differences in scale, an additive term was introduced which determines uniform tax rate increments

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[15] The static CGE model underlying the integrated model is based on estimated trade elasticities and minimum consumption levels for the LES expenditure system, (Arndt, Robinson and Tarp, 2000). These parameters which were estimated on a sample covering 1991-96.

[16] This is necessary since no reliable household consumption pattern were available for 1997 at the time of writing.

[17] Notice that the targeting of nominal GDP through the targeting of real GDP and money demand, is necessary in order to be able to target nominal sectoral GDP for services. This is so since services are not subject to marketing costs per definition.

in order to target government tax revenues.[18] Since government foreign interest payments are also targeted, government savings are tracked. Given the variables which are already targeted, including nominal GDP and remittances, and the further targeting of indirect taxes and private foreign interest payments, private net savings are targeted implicitly by targeting total private consumption. Since data is only available on total private savings, including household and enterprise savings, it is necessary to include a variable which allows for the change in savings to be spread across both households and enterprises. Due to strong differences in scale, it was again decided to include an additive term which determines a uniform increment in the savings rates of enterprises and households. The targeting exercise implies that private savings rates have increased quite strongly by 5 percent between 1995-97.

Turning to the financial sector variables, private and government foreign interest payments are targeted by varying the interest rates applied to the stock of foreign debt from the previous period. The government net foreign debt is targeted by varying the technical parameter which relates debt accumulation to export growth. The level is determined by imposing the initial value. The private net foreign debt is determined residually but is targeted implicitly through the targeting of all other financial variables. However, the level is again determined by imposing the initial value. Private and government savings as well as capital inflows from abroad are already targeted for 1996 as explained above. The remaining financial sector variables can therefore be targeted for 1996 by targeting the three variables which are determined through technical and behavioural specifications. The three variables include the money stock, foreign exchange reserves and government net foreign debt, among which the government debt stock has already been dealt with. The two remaining variables are subsequently targeted by allowing the coefficients of their respective functional forms to vary. Given initial values for all the stock variables it follows that all the financial sector variables are targeted for 1996 and subsequently for 1997.

5. Projections

The integrated model differs from the merged model as a projection tool. It includes general equilibrium features like price-clearing of goods and factor markets. The merged model is generally used as a check on the consistency of an assumed growth path in relation to private and government spending needs and the availability of financial resources. In addition to these kinds of consistency checks, the integrated model allows for additional checks on implied changes in relative prices, implicitly assumed sectoral growth in factor productivity and implied changes in the distribution of income among households. It follows that the integrated model allows for other points of reflection in addition to traditional target variables like government domestic credit expansion.

As noted in the previous section, the integrated model has been calibrated to target the 1995-97 data set underlying the merged model projections in Jensen and Tarp (2000). It follows that the initial values for the integrated model projections and the merged model projections are basically the same. Furthermore, the current projections will be based on the exogenously specified growth paths for several variables as part of the closure of the model. These growth paths are taken from the optimistic scenario included in the merged model projections, implying that the integrated model projections will mimic these projections. The current integrated model projections can therefore be viewed as an extra consistency check on the optimistic scenario from the merged model projections. Parameter values are generally fixed over the projection period at

[18] The term were only added to non-zero tax rates. Specifically, this implies that the factor tax rate on agricultural labour remain zero.

the calibrated values for the 1997 base year.[19]

The closure of the model implies that real and nominal GDP as well as nominal government consumption and investment are targeted at their respective merged model growth paths. Nominal GDP is targeted by tracking the merged model growth path for the money stock and keeping the velocity of money circulation constant. Furthermore, the model closure implies that foreign capital inflows in the form of foreign remittances to households, net foreign transfers to the government and NGOs, and foreign savings inflows are all targeted to their respective merged model growth paths.

The simple dynamics included in the integrated model implies that the projections basically represent a set of successive solutions to a static general equilibrium model. The model closure therefore needs to include a numeraire price index which determines the basic price level for each year. The targeting of both real and nominal GDP at their merged model growth paths implies that the GDP deflator acts as price numeraire for the current integrated model projections. This implies that prices grow at five percent per year. World market prices were also targeted at their merged model growth paths, implying that sectoral export and import US$-prices grow uniformly at three percent per year.

Turning to the factor market, labour supplies are assumed to grow at a constant 2.7 percent per year in line with expected population growth. In contrast, the supply of capital is updated from a specification based on a yearly depreciation rate of 6.7 percent and a rate of return to capital of 20 percent. Since the current projections tracks the merged model growth path for real GDP, the average productivity in the production activities must be allowed to vary. This is achieved by including a multiplicative productivity parameter which restricts sectoral productivity levels to vary proportionately. Since aggregate real GDP grow at around 9 percent per year and the capital stock grow around 10 percent per year, average productivity growth must be around 4 percent per year. This conclusion is different from the merged model projections where productivity growth was not seen as a precondition for such growth rates. The integrated model requires strong productivity growth since it has to make up for a slowly growing labour supply.

Capital-intensity of production imply that industry and service sector GDP grows around 10-11 percent per year. This is qualitatively similar to the merged model projections since industry sector growth rates are higher than service sector growth rates. However, the merged model projections envision higher industry sector growth and lower service sector growth. The current projections therefore seem to imply that the merged model growth paths for sectoral GDP are inconsistent with future developments in the factor markets.[20] On the other hand, the projections may also be taken as evidence that factor productivity growth should not be varying proportionately over time. Agricultural sector GDP is reasonably close to the merged model growth path since factor productivity growth around 4 percent and labour supply growth around 3 percent adds up to sectoral GDP growth around 7 percent.

As noted above, the assumptions included in the closure imply that most variables mimic the merged model projections closely. This is in particular the case for the government account where the overall government budget including tax revenues are tracked closely. The integrated model projections for imports and exports also remain very close to the merged model growth

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[19] The only parameters which does not reflect 1997 base period values are the parameters which relate accumulation of government net foreign debt and foreign exchange reserves to respectively export and import growth. Government debt accumulation is assumed to amount to 200 percent of export growth, while reserve accumulation is assumed to amount to five month of additional imports.

[20] Note that the factor market are not explicitly included in the merged model framework. It is, however, supposed to be taken into account implicitly by the modeller.

paths. They only differ somewhat from the merged model projections due to a small real exchange rate depreciation of around 1 percent per year. Finally, due to the technical and behavioural relationships relating the accumulation of government foreign debt and foreign exchange reserves to export and import growth, projections for foreign debt and domestic credit aggregates as well as other items of the balance of payments develop in a very similar way as well.[21] Having established that the two sets of projections are comparable, we now turn to look at relative prices and the distribution of income between households.

Table 7 presents the price developments which according to the current integrated model projections are needed to support the optimistic scenario of the merged model projections in Jensen and Tarp (2000). Agricultural price indices generally increase faster than goods prices in other sectors. While agricultural producer prices increase twice as fast as industry and service sector prices, moderate price increases in the marketing service sector imply that agricultural consumer prices increase at a more moderate pace. Nevertheless, they still increase considerably faster than other prices. The strong agricultural price increase follows from increasing demand pressures combined with moderate expansions of agricultural goods supply. While agricultural goods imports increase fast, they only constitute a fraction of total supply. Thus, domestic supply of agricultural products are constrained by the moderate expansion of agricultural labour supply, combined with the very rudimentary agricultural production technologies. The widening price differentials in the current projections therefore indicate that bottle necks can arise in relation to a future capital deepening of the economy.

[TABLE 7 ABOUT HERE]

Agricultural import prices expand much slower than domestic prices, underpinning the strong expansion of agricultural imports. In contrast, agricultural export prices expand at much the same pace as domestic prices, serving to limit the expansion of agricultural exports. For industry goods and services it generally follows that world market prices in domestic currency expand faster than domestic prices. The prices in the optimistic scenario therefore underpin the expansion of agricultural imports at the expense of industry and service sector imports. Furthermore, relative prices underpin the expansion of industry and service sector exports to generate foreign currency for the increasing imports. Clearly, relative import, export and domestic prices are driven by the exchange rate and the price of marketing services.

[TABLE 8 ABOUT HERE]

The factor prices presented in Table 9 clearly reflect the assumed economic growth during the projection period. Demand pressures following from the expansion of economy-wide income imply that all demand components expand quickly. Together with factor productivity growth around 4 per cent per year, this causes a relatively strong expansion of factor prices. Moreover, the capital deepening of the economy during the projection period implies that labour wages increase much faster than capital returns. Labour wages increase by between 11-13 percent per year while capital returns increase by around 5 percent per year. The factor returns seem to indicate that rural households with high endowments of labour will benefit the most from economic growth. Thus, rural households experience a strong income expansion in nominal terms.

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[21] For computational reasons the expected debt relief in mid-1999 is not included in the current integrated model projections. However, since effective interest rates have been lowered comparably this does not any major impact on the comparability with the merged model projections. The government is still assumed to be able to borrow what amounts to 200 percent of additional export earnings each year.

However, rural households also have very high budget shares of agricultural products. Their cost of living therefore expands relatively quickly as well.

[TABLE 9 ABOUT HERE]

The differences in the growth paths for factor returns and cost of living indices have implications for the distribution of welfare between households. This can be seen from the measures of equivalent variation, presented in Table 10. The relatively strong nominal income expansion for rural households is not enough to offset the relative increases in living costs. While poor rural households do enjoy a significant improvement in welfare, it is smaller than the welfare improvement for urban households. On the one hand, the moderate increases in the price of marketing services allow agricultural producer prices to increase faster than agricultural consumer prices due to the high agricultural marketing margin rates. This benefit poor rural households which are characterised by a high share of agricultural labour income and high budget shares of agricultural products. On the other hand, the capital deepening of the economy and the associated increases in value added by capital benefit the urban households even stronger. While urban household welfare increases the most, the economic growth path envisioned in the optimistic scenario of the merged model projections improve welfare for both types of households strongly.

[TABLE 10 ABOUT HERE]

6. Conclusion

Traditional tools for making projections are macroeconomic in nature. However, such models lack the possibility of analysing issues related to developments in relative prices and the distribution of income. Taking Mozambican applications of the merged model and CGE model frameworks as a point of departure, it was demonstrated in this paper how the SAM accounting framework can be used to integrate macroeconomic and general equilibrium models. The integrated model is based on a static Mozambican CGE model with simple dynamics and the financial sector from a Mozambican application of the merged model. The integrated model therefore combines the sectoral detail of the CGE model with the macroeconomic focus of the merged model. In particular, the integrated model not only allows the modeller to focus on traditional target variables like government domestic credit. It also makes it possible to focus on more important and fundamental measures like the distribution of income and welfare.

The integrated model was applied on the basis of a Mozambican data set which also forms the basis for a recent set of merged model projections. Imposing economic growth paths from the merged model projections as part of the closure of the integrated model, it appears that growth paths of macroeconomic aggregates are very similar between the two sets of projections. The integrated model projections covering the period 1998-2002 show that the relative producer prices change in favour of agricultural products. Accordingly, agricultural labour wages increase rapidly and this leads to relatively strong income growth for poor rural households in particular. The projections also show, however, that producer price increases spill over into consumer prices for agricultural products. Since the strong nominal income growth for rural households is accompanied by relatively strong increases in rural living costs, the capital-deepening of the economy implies that the distribution of welfare changes in favour of urban households. The worsening of the welfare distribution between households occur even though moderate increases in marketing costs benefit rural households.

Overall, the current integrated model projections indicate that the optimistic scenario from the merged model projections in Jensen and Tarp (2000) is both feasible and sensible when issues related to factor markets, relative prices and income distribution are considered. The implied

average productivity increases average four percent per year, which is feasible at the current level of development in Mozambique. Furthermore, the projections imply that the agricultural labour wages increase strongly; but also that the relative distribution of welfare changes in favour of urban households. The projections raise the issue whether poor rural households are going to benefit from the future capital deepening of the Mozambican economy. This seem to require the introduction of improved production technologies in the agricultural sector which can take advantage of increasing access to capital.

The merged model projections were based primarily on controlling the government domestic credit target variable. This is in line with traditional applications of the financial programming approach. The current integrated model projections show that the optimistic scenario of the merged model projections may have undesirable distributional implications, and that these implications are related to future capital-deepening of the economy and the rudimentary agricultural production technologies used. In general, the integrated model is a strong tool for identifying potential problems with future strategies based on macroeconomic projection tools. It is clear that data requirements are higher for the integrated model as compared to a simple merged model framework. However, SAMs are common in developing by now, so the integrated model represent a feasible and desirable alternative to other macroeconomic projection tools.

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Table 1. Labels of the Macroeconomic Social Accounting Matrix for Mozambique (MACSAM)

Receipts	Expenditures											
	1. Activities	2. Commodities	3. Factors	4. Enterprises	5. Households	6. Recurrent Government	7. Indirect Taxes	8. Government Investment	9. NGO	10. Capital	11. Rest of World	12. Total
1. Activities		Marketed Production			Home Consumption							Total Sales
2. Commodities	Intermediate Consumption				Private Consumption of Marketed Commodities	Government Consumption	Export Subsidies	Government Investment*	NGO Consumption	Non-Government Investment	Exports (FOB)	Total Marketed Commodities
3. Factors	Value Added at Factor Cost											Value Added at Factor Cost
4. Enterprises			Gross Profits			Subsidies						Enterprise Income
5. Households			Wages incl. Mixed Income	Distributed Profits		Social Security					Net Transfers by Workers	Household Income
6. Recurrent Government		Consumption Taxes	Factor Taxes	Enterprise Taxes	Income Taxes		Indirect Tax Revenue to Government					Government Recurrent Receipts
7. Indirect Taxes	Output Taxes	Import Tariffs										Tariffs plus Output Taxes
8. Government Investment											Aid in Government Budget	Government Aid Receipts
9. NGO											Aid in NGO budget	NGO Aid Receipts
10. Capital				Retained Earnings	Household Savings	Government Savings 1		Government Savings 2			Net Capital Inflow**	Total Savings
11. Rest of World		Imports (CIF)										Imports
12. Total	Total Payments	Total Commodity Supply	Value Added at Factor Cost	Enterprise Expenditure	Household Income Allocated	Tax Financed Government Expenditure	Indirect Tax Receipts less Export Subsidies	Government Investment*	NGO Consumption	Non-Government Investment	Foreign Exchange Available	

Includes extraordinary items ('programas especiais'*) sometimes registered as recurrent expenditure.

**Amounting, in principle, to the sum of the balance of payments entries not appearing elsewhere in row or column 9.

Table 2. Real side of the merged model in a SAM framework

Receipts	Outlays							
	1. Production sector	2. Private recurrent	3. Government Recurrent	4. Government Investment	5. NGO	6. Private Investment	7. Rest of World	8. Total
1. Production sector		Private Consumption	Government Consumption	Government Investment	NGO Consumption	Non-Government Investment	Exports (FOB)	Final Demand
2. Private recurrent	Value Added at Market Price		Government Transfers				Net Transfers by Workers	Private Income
3. Government Recurrent		Direct and Indirect Taxes						Government Recurrent Receipts
4. Government Investment							Aid in Government Budget	Government Aid Receipts
5. NGO							Aid in NGO Budget	NGO Aid Receipts
6. Private Investment		Private Gross Savings	Government Gross Savings	Government Investment Budget Deficit			Net Capital Inflow	Total Savings
7. Rest of World	Imports (CIF)							Imports
8. Total	Supply for Final Demand	Private Income Allocated	Govt. Recurrent Expenditure	Govt. Investment	NGO Expenditure	Private Investment	Foreign Exchange Available	

Table 3. Financial side of the merged model in a SAM framework

Receipts						
	1. Domestic Capital Market	2. Foreign Capital Market	3. Private Investment	4. Government Investment	5. Savings-investment balance	6. Total
1. Domestic Capital Market			Change in Broad Money			Change in Money Demand
2. Foreign Capital Market	Change in Forex Reserves				Current Account Deficit	Change in Foreign Assets
3. Private Investment	Change in Private Domestic Credit	Change in the Private Foreign Debt plus Revaluation of Forex Reserves			Private Savings	Demand for Private Assets
4. Government Investment	Change in Government Domestic Credit	Change in the Government Foreign Debt			Government Savings plus Net Foreign Transfers	Demand for Government Assets
5. Savings-investment balance			Private Investment Expenditures	Government Investment Expenditures		Total Investment
6. Total	Change in Money Supply	Change in Foreign Liabilities	Supply of Private Assets	Supply of Government Assets	Total Savings	

Table 4. Merged model real side variables in a SAM framework

Receipts	1. Production sector	2. Private sector	3. Govt. Recurrent	4. Govt. Investment	5. NGO	6. Capital	7. Rest of World	8. Total
1. Production		P*CP	P*CG	P*IVG	P*CN	P*IVP	E*XPI*X	Net Commodity Demand
2. Private sector	GDP		GT				E*(NFP + NTRP)	Private Income
3. Government Recurrent		TG						Govt. Recurrent Receipts
4. Government Investment							E*(NTRG - INFG)	Govt. Aid Receipts
5. NGO							E* NTRNGO	NGO Aid Receipts
6. Capital		SP +E*INFP	SG + E*INFG	- BRG-SG - E*INFG			E*(-INFP -CURBAL)	Total Savings
7. Rest of World	E*MPI*M							Imports
8. Total	Net Commodity Supply	Private Income Allocated	Govt. Recurrent Expenditure	Govt. Investment	NGO Expenditure	Private Investment	Foreign Exchange Available	

Note: variable names are defined in the appendix.

Table 5. Merged model financial side variables in a SAM framework

Receipts	1. Domestic Money Market	2. Foreign Capital Market	3. Private Investment	4. Government Investment	5. Savings-investment balance	6. Total
1. Domestic Money Market			ΔMD			Money Demand
2. Foreign Capital Market	Δ(E*R)				-E*CURBAL	Demand for Foreign Currency
3. Private Investment	ΔDCP	E*ΔNFDP + ΔE*R(-1)			SP	Demand for Private Assets
4. Government Investment	ΔDCG	E*ΔNFDG			SG + E*NTRG	Demand for Government Assets
5. Savings-investment balance			P*IVP	P*IVG		Total Investment
6. Total	Money Supply	Supply of Foreign Currency	Supply of Private Assets	Supply of Government Assets	Total Savings	

Note: variable names are defined in the appendix.

Table 6. CGE model variables in a SAM framework

Receipts	Expenditures											
	1. Activities	2. Commodities	3. Factors	4. Enterprises	5. Households	6. Recurrent Government	7. Indirect Taxes	8. Government Investment	9. NGO	10. Capital	11. Rest of World	12. Total
1. Activities		PDC*DC			PDCH*DCH							Total Sales
2. Commodities	PC*INT				PC*CD	PC*CG	-EXPTAX	PC*GI	PC*NGOD	PC*CI	PE*E	Total Marketed Commodities
3. Factors	WF*FDSC											Value Added at Factor Cost
4. Enterprises			$(1-TF_{ep})$* WF*FDSC$_{ep}$			GOVTE						Enterprise Income
5. Households			$(1-TF_{hf})$* WF*FDSC$_{hf}$	DISTR		GOVTH					EXR*REMIT	Household Income
6. Recurrent Government		CONTAX	FACTAX	ENTTAX	HHTAX		INDTAX+ TARIFF+ EXPTAX					Government Recurrent Receipts
7. Indirect Taxes	INDTAX	TARIFF										Tariffs plus Output Taxes
8. Government Investment											EXR* FAIDGIN	Government Aid Receipts
9. NGO											EXR* FAIDNGO	NGO Aid Receipts
10. Capital				ENTSAV	HHSAV	GRESAV		GINSAV			EXR*FSAV	Total Savings
11. Rest of World		PM*M										Imports
12. Total	Total Payments	Total Commodity Supply	Value Added at Factor Cost	Enterprise Expenditure	Household Income Allocated	Tax Financed Government Expenditure	Indirect Tax Receipts less Export Subsidies	Government Investment*	NGO Consumption	Non-Government Investment	Foreign Exchange Available	

Note: variable names are defined in the appendix.

Table 7. Price indices (%)

		1998	1999	2000	2001	2002
Producer prices	Agriculture	9.6	8.1	8.1	8.2	8.3
	Industry	4.1	4.4	4.3	4.2	4.2
	Ordinary services	4.4	4.6	4.4	4.3	4.3
	Marketing services	2.8	3.5	3.4	3.3	3.3
Consumer prices	Agriculture	6.8	6.3	6.3	6.4	6.5
	Industry	4.2	4.6	4.6	4.6	4.6
	Ordinary services	4.5	4.7	4.6	4.5	4.5
	Exchange rate	2.5	2.8	3.0	3.1	3.1

Table 8. Domestic world market prices

		1998	1999	2000	2001	2002
Import prices	Agriculture	4.7	5.1	5.3	5.3	5.3
	Industry	4.7	5.1	5.3	5.4	5.3
	Ordinary services	5.5	5.8	6.1	6.2	6.2
Export prices	Agriculture	7.6	7.5	7.9	8.0	8.0
	Industry	6.1	6.3	6.5	6.7	6.7
	Ordinary services	5.5	5.8	6.1	6.2	6.2

Table 9. Factor returns

	1998	1999	2000	2001	2002
Agricultural labour	13.7	12.7	12.9	13.1	13.2
Non-agricultural labour	11.6	11.5	11.4	11.5	11.6
Capital	2.4	4.9	5.1	5.0	4.7

Table 10. Equivalent variation (% of base income)

	base income	1998	1999	2000	2001	2002
urban households	121.0	8.6	15.7	21.6	26.5	30.5
rural households	113.0	8.0	14.4	19.8	24.1	27.4

Appendix: Model variables

Merged model variables

Variable	Description
CP	Private real consumption
CG	Government real consumption
CN	NGO rela consumption
IVP	Private real investment
IVG	Government real investment
X	Real exports
M	Real imports
GDP	real GDP
TG	Government transfers to the private sector
GT	Government tax revenues
BRG	Government borrowing requirement
SP	Private savings
SG	Government savings
INFP	Private net foreign interest payments
INFG	Government net foreign interest payments
NFP	Net factor payments
NTRP	Private net foreign transfers from abroad
NTRG	Government net foreign transfers from abroad
NTRNGO	NGO net transfers from abroad
CURBAL	Current account balance
DCP	Private domestic credit taking
DCG	Government domestic credit taking
R	Foreign exchange reserve holdings
MD	Money stock
NFDP	Private net foreign debt
NFDG	Government net foreign debt
PD	GDP deflator
P	Absorption deflator
XPI	World market price deflator for exports
MPI	World market price deflator for imports
E	Exchange rate

CGE model variables

Variable	Description
CD	Private real consumption
CG	Government real consumption
NGOD	NGO rela consumption
CI	Private real investment
GI	Government real investment
E	Real exports
M	Real imports
INT	Real intermediate consumption
DC	Marketed production
DCH	Home consumed production
FDSC	Factor demand
DISTR	Distributed profits
GOVTE	Government transfers to enterprises
GOVTH	Government transfers to households
INDTAX	Indirect taxes
CONTAX	Consumption taxes
FACTAX	Factor taxes
ENTTAX	Enterprise taxes
HHTAX	Household taxes
EXPTAX	Export taxes
TARIFF	Import tariffs
ENTSAV	Enterprise savings
HHSAV	Household savings
GRESAV	Government recurrent budget savings
GINSAV	Government investment budget savings
REMIT	Remittances from workers abroad
FAIDGIN	Foreign aid in the government budget
FAIDNGO	Foreign aid in the NGO budget
FSAV	Foreign savings
PDC	Retail price
PDCH	Farm gate price
PC	Consumer price
PE	Export price in domestic currency
PM	Import price in domestic price
EXR	Exchange rate